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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/823,351	04/12/2004	John Erik Lindholm	NVDA/P000835	4725
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EXAMINER YANG, RYAN R				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/823,351

Applicant(s)

LINDHOLM ET AL.

Examiner

Ryan R. Yang

Art Unit

2628

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 December 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-27 is/are pending in the application.
- 4a) Of the above claim(s) 3-5, 7, 16, 17 and 19 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1, 2, 6, 8-12, 24-27 is/are allowed.
- 6) ☒ Claim(s) 13-15, 18 and 20-23 is/are rejected.
- 7) ☒ Claim(s) 23 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 10/15/07.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

1. This action is responsive to communications: Amendment, filed on 12/7/2002.

This action is non-final.

2. Claims 1, 2, 6, 8-15, 18, 20-27 are pending in this application. Claims 1, 13, 20 and 24 are independent claims. In the Amendment, filed on 12/7/2007, claims 1, 2, 8, 13, 20 and 24 were amended, claims 3-5, 7, 16, 17 and 19 were canceled, and claims 26 and 27 were added.

3. The present title of the invention is "System and method for synchronizing samples in a programmable graphics processing unit".

Claim Rejections - 35 USC § 102

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 13-15 and 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Lindholm et al. (US 7,015,913)

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

6. As per claim 13, Lindholm et al., hereinafter Lindholm discloses a method for processing divergent graphics samples in a programmable graphics processing unit, the method comprising:

processing samples of a group of samples in non-divergent mode ("FIG 6 ... Instruction Scheduler 430 to schedule the execution of program instructions to process several samples", column 13, line 60-42);

determining whether each program counter of a plurality of program counters is the same, each program counter of the plurality of program counters corresponding to a different one of the samples of the group of samples ("In one embodiment, instructions with equal program counter are considered synchronized", column 14, line 2-3);

determining whether each subroutine depth of a plurality of subroutine depths is the same, each subroutine depth of the plurality of subroutine depths corresponding to a different one of the samples of the group of samples ("In another embodiment, in addition to program counters, thread state data such as stack depths, nesting levels, subroutine calls, or the like are used to determine two or more threads are synchronized", column 14, line 3-7);

processing each of the other samples in the group of samples in non-divergent mode, after processing the one or more divergent samples ("Instruction Scheduler 430 determines if a synchronization mode is enabled. If in step 620 Instruction Scheduler 430 determines a synchronization mode is enabled, in step 625 Instruction Scheduler 430 checks for synchronization and proceeds to step 630", column 13, line 65- column 14, line 2, where prior to the step, divergent samples were processed).

7. As per claim 14, Lindholm demonstrated all the elements as disclosed in the rejected claim 13, and further discloses the step of processing one or more divergent samples through a remainder of a program if a first program counter of the plurality of program counters is different than a second program counter of the plurality of program counters ("In step 545 Execution Unit 470 also updates the program counter associated with the thread when a branch or loop instruction is executed and the program counter is different than the program counter updated in step 540. In step 547 Execution Unit 470 determines there are no more instructions in the thread, and, if so, return to step 535", column 13, line 6-11).

8. As per claim 15, Lindholm demonstrated all the elements as disclosed in the rejected claim 14, and further discloses the first program counter being different than the second program counter results from a conditional branch or a jump (column 13, line 7-8).

9. As per claim 18, Lindholm demonstrated all the elements as disclosed in the rejected claim 13, and further discloses the first subroutine depth being different than the second subroutine depth relates to a call-return ("in addition to program counters, thread state data such as stack depths, nesting levels, subroutine calls, or the like are used to determine thread age", column 9, line 11-14, where the subroutine call represents a call-return).

Claim Rejections - 35 USC § 103

10. Claims 20 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rishi et al. (US 5,953,530) and further in view of Miller et al. (US 2004/0068730).

As per claim 20, Rishi et al., hereinafter Rishi, discloses a system for synchronizing divergent graphics samples in a programmable graphics processing unit, the system comprising:

a plurality of processing threads, each processing thread corresponding to a different sample of a group of samples and configured to contain a program counter, a subroutine depth and state data ("FIG. 4 depicts a representation multi-processor machine configuration which would be typical for use with a multi-threaded target program", column 10, line 49-51); and

a plurality of stacks, each stack corresponding to a different sample of the group of samples and configured to store state data in one or more stack levels ("A thread has a program counter (PC) and a stack to keep track of local variables and return addresses", column 1, line 45-47).

Rishi discloses a method of synchronizing divergent graphics sample. It is noted that Rishi does not explicitly disclose "wherein a first portion of each stack resides in a dedicated local storage resource and a second portion of each stack resides in local memory". However, this is known in the art as taught by Miller et al., hereinafter Miller. Miller discloses a method of affinitizing threads in which "each of the threads 2101 to 260k maintains its own local variables and local resources such as program counter. They also share common global variables and memory", [0041].

Thus, it would have been obvious to incorporate the teaching of Miller into Rishi because Rishi discloses a method of synchronizing divergent graphics samples and

Miller discloses stack memory could be stored in global and local memory in order to provide flexibility in sharing data.

11. . Claim 23, contains limitation include in claim 20, therefore is for the similar reason as claim 20.

12. Claims 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rishi et al. and Miller et al. as applied to claim 20 above, and further in view of Cosgrove et al. (4,399,507).

As per claim 21, Rishi and Miller demonstrated all the elements as disclosed in the rejected claim 20.

Rishi and Miller disclose a method of synchronizing divergent graphics samples. It is noted Rishi and Miller do not explicitly disclose wherein the subroutine depth of a first sample is equal to the number of the one or more stack levels of a first stack that contain state data, the first stack corresponding to the first sample, however, this is known in the art as taught by Cosgrove et al., hereinafter Cosgrove. Cosgrove discloses an instruction-pipelined processor in which "64 level stack 10 which is addressed with a 6-bit stack Pointer (SP) 28 allows nesting up to 64 levels of Subroutine and Interrupt routines", column 11, line 59-61).

Thus, it would have been obvious to one of ordinary skill in the art to incorporate the teaching of Cosgrove into Rishi and Miller because Rishi and Miller disclose a method synchronizing divergent graphics samples and Cosgrove discloses the subroutine instruction can be tracked with leveled stack in order to track the routines.

13. As per claim 22, Rishi and Miller demonstrated all the elements as disclosed in the rejected claim 20.

Rishi and Miller disclose a method of synchronizing divergent graphics samples. It is noted Rishi and Miller do not explicitly disclose wherein each stack resides in a dedicated local storage resource, however, this is known in the art as taught by Cosgrove. Cosgrove discloses an instruction-pipelined processor in which stack is stored locally (Figure 5, item 10).

Thus, it would have been obvious to one of ordinary skill in the art to incorporate the teaching of Cosgrove into Rishi and Miller because Rishi and Miller disclose a method synchronizing divergent graphics samples and Cosgrove a locally stored stack could be used to rack subroutines in order to conveniently tracking the routine.

Specification

14. Claim 23 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 23 limitation does not further limit claim 20.

Allowable Subject Matter

15. Claims 1, 2, 6, 8-12 and 24-27 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

As per claims 1 and 24, the closest prior art by Lindholm et al. (7,015,913), Puzak or Kishi do not explicitly disclose

synchronizing the subset of samples with the other samples of the group for processing a next instruction in the instruction sequence only if all the samples of the subset have encountered the first synch token.

As per claims 13-15, 18 and 20-23, upon further consideration of existing and newly found prior art, the claims are rejected as stated above.

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Inquiries

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ryan R. Yang whose telephone number is (571) 272-7666. The examiner can normally be reached on M-F 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Razavi can be reached on (571) 272-7664. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Ryan R Yang/
Primary Examiner, Art Unit 2628
March 14, 2008